At Renaissance apartment existing carriage way is retaining	Pot holes and patch work at ch 600

Figure 3-1 Photos Taken during Road Inventory for Abbigere Main Road

3.3.2 Road Condition Survey:

Detailed field studies have been carried out to collect pavement, footpath, and drainage conditions. Table 3-3 below shows the details of pavement condition survey, the related photos taken during the road condition, are shown in Figure 3-2 below.

Pavement condition survey was carried out for the project roads. From the survey it is observed that the overall road surface of Renaissance wood apartment (RWA)to Gangamma Gudi Road was in poor condition. Cracks or distress has been noticed at many sections. Percentage cracking is 20% in RWA to Wimac junction and 3% in wimac junction to Gangammagudi Police station road.

Table 3-2 Pavement Condition Survey

Pavement Condition Type	850m length from Renaissance wood apartment to Wimac Junction				Wimac Junction to Gangamma Gudi police station 380M Length			
	L	A	% in area	% in Length	L	A	% in area	% in Length
Pavement cracking	177.00	222.75	3.28	20.82	217.00	358.00	2.29	57.11
Potholes		0.00	0.00			0.30	0.01	
Patching	166.50	1339.25	19.69	19.59	18.00	13.50	0.59	4.74
Ravaling	147.00	913.00	13.43	17.29	40.00	80.00	3.51	10.53

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Table 3-3 Road Condition Survey for Abbigere Main Road

Near Grave yard road patch work	Bituminous layer overlaid on cracked surface

Figure 3-2 Photos Taken during Road Condition Survey for Abbigere Main Road

3.3 Pavement Structure and Strength

Benkelman Beam Deflection (BBD) equipment has been mobilized to conduct the test to assess the Characteristic deflections as per IRC: 81-1997 to evaluate the strength of Pavement.

During the study it was observed the abnormal deflection due to poor condition of existing pavement with many patch works, pot holes, and edge breaking. It is also observed that shoulder portions widened without proper base and lot of depression and undulations were observed. Surface of the main road is so deteriorated that bituminous layers are wearied up and needs to be re-laid from the sub base course. Hence survey has not been carried out. However the sub-base course of the 500 meter long road in the central parts is in good condition.

4 Structural Inventory Survey

The project road of length 1230 m has structures like small Culverts at Ch 400 m near Ashoka College with 3 spans of 1.5 to 2m span with height of 1.2m stone masonry structure and is in poor condition.

Detailed Topographic Survey

Objective: The basic objective of the topographic survey is to collect the essential ground features along the project corridors. The data collected will be useful for the detailed design and for the computation of quantities. The topographic survey work consists of reconnaissance survey, establishing DGPS points, fixing of BM pillars, horizontal

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traversing, vertical traversing, leveling and detailed topographical survey to capture all details, preparation of drawing and submission of report.

Initially, the survey team has to visit the whole area to be surveyed to understand the actual ground conditions prevailing in the corridor and to assess the logistic. Based on this survey, separate survey teams will be mobilized for fixing of control pillars, for traversing, leveling and for detail survey.

Instruments to be used for Topographical Survey

The Topographic survey is undertaken by Total Station and GPS to develop a Digital Terrain Model (DTM). The consultants being fully aware of the high standards aimed at for project preparation and propose the use of the following latest instruments of high accuracy.

Digital Global Positioning System

The basic plan control points (Primary Points) will be established by dual frequency GPS observation, using Leica GS08 Plus static Glonass with RTK/ Promark DGPS with static, providing a pair of primary control points along the proposed road section on permanent reference pillars.

Total Stations

Total stations of Leica TS06/ Nikon DTM 652 of 1sec accuracy and/or Nikon DTM352/ Nikon Nivo/ Leica TC705/ Topcon GTS 235N of 5sec accuracy will be deployed for topographic survey work.

Digital / Auto levels

Digital / Auto levels of Leica Sprinter/Sokkia C320 or equivalent with standard deviation of 1 mm per 1 km double run leveling using bar coded telescopic leveling staves with least count of 0.1 mm/ 0.5 mm will be deployed.

Fixing of Horizontal and Vertical Control Points

The horizontal control points shall be fixed using Global Positioning System along the alignment. Control Pillar of size 30cm x 30cm x 60cm shall be cast in RCC of grade M15 with a nail fixed in the centre of the top surface. The reference pillar shall be embedded in concrete up to a depth of 45 cm with PCC M10 (15 cm wide all around). The portion above ground shall be painted yellow. The spacing shall be 5km apart.

Bench Mark pillar of size 15cm x 15cm x 45cm shall be cast in RCC of grade M 15 with a nail fixed in the center of the top surface. The reference pillar shall be embedded in concrete up to a depth of 30cm with CC M10 (5cm wide all around), the balance 15 cm above ground shall be painted yellow. The spacing shall be 250m apart in straight alignment. The

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final RL (w.r.to GTS) and BM No. will be marked on the reference/BM pillars with red paint.

Horizontal Traverse

The co-ordinate system for the survey will be based on the Global Positioning System. The traversing will be started using the GPS co-ordinates and carried out the traversing using the reference pillars and nail points. The whole stretch is divided into different divisions to make horizontal traverse loops to have checks and counter checks for the traverse work. Each division of loop consists of 3 to 5 km stretch. Each horizontal loop will have the accuracy of more than 1:20,000, which satisfies minimum requirements.

Leveling Loops The leveling loop line was carried out using Auto level instrument (Sokkia C31) and the reduced levels of GPS and Traverse Station using the control pillars and nail points. Double run leveling was carried out along smaller circuits of 3 km – 5 km lengths ensuring the required accuracy within the tolerance limit of 12K mm, where K is the length covered in km.

Detailed Topographical Survey

After finalizing the X, Y and Z values based on the horizontal and vertical traverse loops, the detailed topographical survey is carried out capturing all the existing features. The survey is extend a minimum 30m beyond either side of centreline of proposed carriageway or land boundary whichever is more. For the 4-laning/6-laning project and intersections, the survey is extend to 50m on either side of the centre line. The work includes Longitudinal and Cross sections details including all the existing features along the project corridor.

Longitudinal and Cross sections

The topographic surveys for longitudinal and cross-sections shall cover the following:

a. Longitudinal section levels along final center line at every 20 m interval and at every under meter intervals at the locations of curve points, small streams, and intersections and at the locations of change in elevation.

b. Cross sections at every 20 m interval in full extent of survey covering sufficient number of spot levels on existing carriageway and adjacent ground for profile correction course and earth work calculations. Cross sections shall be taken at every 10 m or closer interval at curves.

c. Longitudinal section for cross roads for length adequate for design and quantity estimation purposes.

d. Longitudinal and cross sections for major and minor streams as per recommendations contained in IRC Special Publication No. 13 (Guidelines for the Design of Small Bridges and Culverts) and IRC:5-1998 ("Standard Specifications &

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Code of Practice for Road Bridges, Section 1 - General Features of Design"), whenever new bridges / shall culverts are proposed.

Collection of Topographical Features

All landside features given below, but not limited to, will be captured, within this corridor and presented in drawings.

i. Electrical Poles, Telephone Poles, Lamp Poles and any other Private/Unauthorized utility Poles with their routing network.

ii. Water / Sewerage / Oil / Gas Pipe Lines with diameter and material of the pipe.

iii. All Utility lines, both overhead and underground.

iv. Manholes – with their actual size and shape (ex. rectangular or square or circular)

v. Trees with girth more than or equal to 0.3m - while surveying the trees, care is taken to exactly classify the trees according to its girth.

vi. Building lines indicating the type of buildings (shops or houses), right of way boundary if available at site by presence of boundary stones.

vii. Sufficient road center points, edge points and shoulder points are taken to define the existing layout of the roadway.

viii. Approach road details of 50m lengths are recorded on either side of the road. But on important junctions, length of road to be surveyed is subjected to a minimum length of 500m.

ix. Location of traffic islands, median, channelizing islands, rotaries, police chowkis, (top and bottom levels are must for all these) with its locations, and dimensions.

x. Location of bus bays / bus stops, truck - parking areas, taper length, roadway width.

xi. Locations of roadside drain clearly identifying the type, width of drain, invert level including the beginning and end of drain.

xii. All water features such as ponds, tanks, lakes, streams, canals and wells etc

xiii. All water bodies such as canals, nallas with details such as width, depth, levels, leadoff points, levels to an extent of 100 m length on either side of road.

xiv. Details of water logged areas with extent, depth etc.,

xv. Land use on either sides of load chainage wise like cultivation with type of crop, barren land, forest land, water bodies with extension (perennial or seasonal) and distance from existing road edge.

xvi. Commercial establishments with names on either side of existing road.

xvii. Educational institution, Hospitals, religious places, grave yard, etc with details, extent, distance from road etc on either side of road. The details shall include location of entrance, compound walls/boundary lines, no of beds in case of hospital, etc.

xviii. Notified forest area including fencing including boundary extents.

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xix. Identification of all cross drainage structures (Bridges & culverts) – levels and extents of headwall / return wall, width of deck across road, Deck top, deck bottom, no of spans, skew angle, direction of flow, width of piers / abutment, pipe no and dia in case of pipe culverts, invert levels of culverts, cross section of stream at every 50m for a length of 200m both on u/s and d/s for minor streams and at every 150m for a length of 600m on u/s & d/s for major rivers.

Identification of RoB/RUB – levels at road level, top of rail, extents of headwall / return wall, width of deck, Deck top, deck bottom, no of spans, skew angle, railway chainage km, bridge number.

The photos captured during the survey are shown in

Topographical Survey at Gangammagudi Police station

Total Station Survey at Gammagudi Police station

Figure 3-3

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Topographical Survey at Gangammagudi Police station

Total Station Survey at Gammagudi Police station

Figure 3-3 Photos captured during Topographical Survey

3.5 Geotechnical Investigation

Sub-soil formations are complex in nature. It is generally observed that soil properties vary significantly with depth and laterally at any given site. This inherent variability and complexity of soil properties make soil investigation essential for all civil engineering projects. Proper identification of various soil strata, the lateral variability of strata in depth and thickness, determination of the type of soil and various engineering properties and their variability within each stratum are essential. Subgrade soil has been investigated to determine soil type and strength.

3.5.1 Subgrade Investigation

a. Subgrade Soil Investigations

The improvement proposal from Ch 00 to 1230 m involves augmenting existing single lane bituminous road to two lanes with service road facility. The widening portion of pavement will be supported on natural ground and hence, soil characteristics of existing soil are important in design of pavement structure. Soil characteristics / properties are determined on natural soil of existing road.

Test pits of approx. 1.5 m x 1.5 m size staggered along the edge of the existing pavement was excavated up to sub grade level (up to 1.5m depth). Approximately 15 kg of soil sample (representing sub grade material) from test pit is collected and tested for Grain size analysis,

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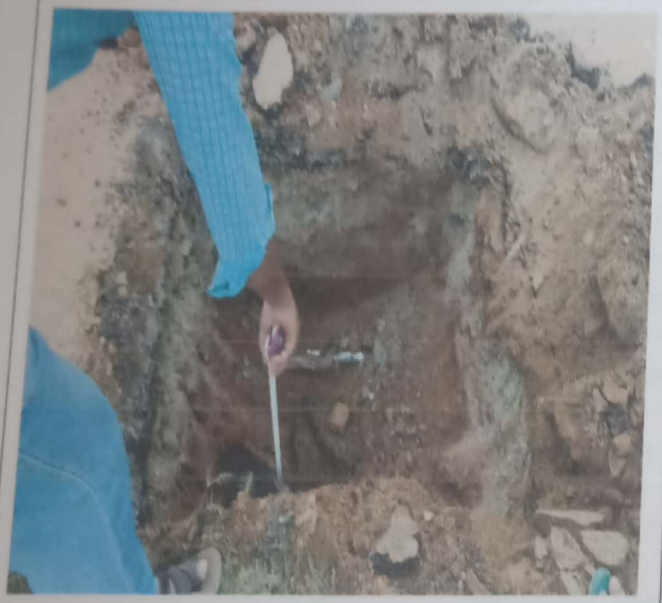
Liquid limit (LL), Plastic Limit , Modified Proctor test (for Maximum dry density, MDD & Optimum moisture content, OMC) and 4 days Soaked CBR.

The following field and laboratory tests have been carried out on each test pit as described below: Field Dry density test by sand replacement method at the bottom of pit was carried out and the degree of compaction (existing) in field was determined.

b. Existing Pavement Composition

Existing pavement composition along the project road stretch was reviewed from the test pits. The existing crust composition details measured during the investigation and revels that pavement is having composition of Natural earth with GSB/WMM 200 mm DBM BC 100 mm. Photo of the investigation pit is shown in the Figure 3-4 below.



Test Pit for Pavement composition and Soil Investigation at Gove School Abbigere main road and near Ashoka College

Figure 3-4 Photo showing the existing crust of Pavement

c. Laboratory Tests Results of Samples

The soil samples of the sub grade collected from the test pits are tested in the laboratory and the test results for Grain size classification, Atterberg limits, MDD, corresponding OMC and CBR values etc. are given in Table 3-4 below.

Table 3-4 Soil Samples Test Results for Abbigere Main Road

Sl. No	Test	Result

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Sl. No	Test	Result
Field Test		
1	Field CBR (%)	4.0
2	Field Moisture Content (%)	11.6
3	Field Density (Gm/cc)	1.89
4	Bearing Capacity of Soil	16t/cum
Laboratory Tests		
1	OMC (%)	12.3
2	Max Dry Density (Gms/cc)	1.69
3	Soaked CBR (%)	2.3
4	UN Soaked CBR (%)	4.3
5	Free Swell Index (%)	53
6	Classification of Soil	CI
7	Liquid Limit	42
8	Plastic Limit	24.5
9	Plasticity Index	17.5
10	Sieve Analysis in (%)	
	Gravel	3
	Sand	35
	Silty & Clay	62
11	Angle of Internal Friction	12
12	Cohesion in t/m^2	3.1

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3.5.2 BBD/Deflectometer

Benkelman Beam Deflection tests or rebound deflection tests were not conducted along the project road since the existing road is completely weakened in strength due to poor subgrade , subcase and base course, improper densification, potholes, patchworks, existing on the present road which requires re construction from subgrade to base course. However, a short length of 400 to 500 meters at the center portion could be retained by removing the bituminous surface for a wide of 5 to 6 m and recomposing with WMM corrective course.

3.5.3 Traffic volume counts

The traffic volume count surveys were conducted for Fifteen hours from morning 6am to evening 9pm to obtain classified count at the identified locations. The data was collected on working day by deploying enumerators to record data for each hour within fifteen minutes intervals to obtain data on the magnitude of traffic flow, hourly variation and the traffic composition. Analysis of survey datas are discussed in the chapter 4 Traffic survey and Analysis

3.6 Cost Estimate and Bill of Quantities

The rate of materials adopted in the preliminary cost estimate are based on the basic rates of Karnataka PWD, Bengaluru Circle S.O.R. 2018-19 and updated with respect to increase in Basic rates of Bituminous materials and as modified by the PWD for the items related to Bituminous works, cement and steel are considered for estimate. For the working out of preliminary cost estimate, work items are split into the following sub-heads shown in the

Table 3-5

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Sl. No	Descriptions of Provisions
1	Site Clearance & Dismantling (Bill No. 1)
2	Earth work for Excavation & Subgrade (Bill No. 2)
3	Concrete of all grade and Steel Work for Drain, Manhole, Basement for Street Light Pole (Bill No. 3)
4	Sub Base work for GSB & WMM (Bill No. 4)
5	Masonry and Finishing works for Footpath, Kerb, utility Duct etc (Bill No. 5)
6	Base and Surface work for DBM & BC (Bill No. 6)
7	Pavement marking and Road Appurtenances (Bill No. 7)
8	Electrical works for laying LT Cable for LED Street Lights. (Bill No. 8)
9	Construction of Recharge pits for Rain water Harvesting (Bill No. 9)
10	Tree Plantation and Transplantation (Bill No. 10)

4 Traffic Survey and Analysis

4.1 General

The present chapter on traffic survey and analysis presents the existing traffic characteristics, methodology used to derive traffic growth rates, details on adopted traffic growth rates, forecasted traffic on the project road. Based on these the results of analysis and recommendations for improvements are discussed in the following sections.

The methodology adopted for traffic surveys is as per IRC standards. A thorough knowledge of traffic travel characteristics is required for future traffic estimation. Therefore, traffic surveys have been conducted to assess the basic traffic characteristics of the area surrounding the project

The study aims at obtaining the existing traffic and travel characteristics on the project road and forecasting the average annual daily traffic for project horizon year considering various consistent streams and for various scenarios. Classified Volume Counts

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The traffic count surveys were conducted for Fifteen hours from morning 6am to evening 9pm to obtain classified count at the identified locations. The data was collected on working day by deploying enumerators to record data for each hour within fifteen minutes intervals to obtain data on the magnitude of traffic flow, hourly variation and the traffic composition.

The survey was carried out by manual vehicle counting and classifying the vehicles passing the survey station in both directions, in 15 minutes intervals. The counts were made separately for motorized and non-motorized traffic as per the vehicle classification system shown in Table 4-1 below: All the surveys were conducted through trained enumerators and were supervised by traffic engineers.

Table 4-1 Vehicle Classification

Motorised Traffic		**Non-Motorised Traffic**
2-Wheelers		Bicycle
3-Wheelers		Cycle Rickshaw
Passenger Car		Animal Drawn Vehicle (ADV)
Utility Vehicle (Jeep, Van etc)		Hand Cart
		Other Non-Motorized Vehicle
Bus	Mini Bus	
	Standard Bus	
LCV	LCV - Passenger	
	LCV - Freight	
Agriculture Tractor	With Trailor	
	Without Trailor	
Truck	MCV : 2 Axle Rigid Chassis	
	HCV : 3 Axle Rigid Chassis	
MAV	4 to 6 Axle Rigid Chassis	
	7 or more Axle Rigid Chassis	

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4.2 Traffic Survey Location

The traffic survey locations for conducting traffic volume count survey were identified by the Consultants after the reconnaissance survey of Road section and the surrounding road network. The following points were considered while selecting survey location:

- The station should represent homogeneous traffic section
- The station should be located in a reasonably level terrain with good visibility

The traffic survey classified volume count (CVC) schedule is presented in Table 4-2

Table 4-2 Schedule for Classified Volume Count Survey

Sl.No	Name of Station	Direction of Traffic flow	Date of Survey
Abbigere main road - Renaissance wood Apartment			
1	CVC-1	At Ashoka College	30-06-2020
Renaissance wood Apartment to Abbigere main road			
2	CVC-2	At Ashoka College	30-06-2020

The survey data and ADT of each survey locations is presented in Annexure-4.1

4.3 Traffic Volume Characteristics

Traffic volume count data collected at different locations has been analyzed to arrive hourly variation and composition. Total vehicles are worked out. Since the data collected from the site for the various vehicle types having different sizes and characteristics are to be converted into a standard equivalent unit called Passenger Car Unit (PCU) has been adopted .The PCU conversion factors adopted for the present study are given in Table 4-3 and are taken from "IRC 106-1990: Guidelines for capacity of Urban Roads in Plain Areas"

Table 4-3 Adopted PCU Values

Vehicle Type	PCU Factor
Two Wheelers	0.75
Auto Rickshaw	2.0
Car	1.0
Mini Bus	1.0
Standard Bus	2.2

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Vehicle Type	PCU Factor
Light Truck (LCV)	1.4
Medium Truck (HCV)	2.2
MAV	4.0
Agricultural Tractor	4.0
Animal Drawn	1.5
Hand Drawn	2.0
Cycle	0.4

4.4 Traffic Survey from Abbigere Main road to Renaissance wood Apartment (from Ch. 1230 to 0)

4.1 Analysis of Classified Traffic Volume Counts

Classified Volume Count Survey at Point-1 is carried out at mid-block of Abbigere road to Wood apartment. Traffic flow is two way direction from wimac junction to Wood apartment. CVC is done for one day count from morning 6 am to evening 9 pm for 15 hours to assess the volume of traffic flow. This location survey is analyzed to obtain the following traffic characteristics:

- Average hourly variation of traffic volume
- Average Composition of traffic

The project road observes about 28656 Vehicles (32269 PCU) covering Morning to Evening including Peak hours. Hourly counts of different types of vehicles are shown in the

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Table 4-4 Classified Volume Count of different types of vehicles

Timings	Standard Buses	Mini Buses	Cars/ Jeeps	Pickup Vans/ Maxicabs	Two Wheelers	Passenger Auto	2-Axle Trucks	3-Axle Trucks	MAVs	LCVs	GOODs AUTO	Tractor Trailer	Bi-Cycles/Cycle Rickshaw	Hand cart/Animal Drawn	Others	Total Vehicles	Total Vehicles in PCU
06.00-07.00	15	4	256	17	380	148	6	1	1	34	8	0	48	0	0	957	1029
07.00-08.00	24	16	740	27	856	240	3	3	0	24	0	0	62	0	5	2002	2096
08.00 - 09.00	16	2	853	7	1252	368	3	3	0	27	0	0	36	0	0	2587	2693
09.00 - 10.00	10	1	755	8	1353	566	1	0	0	19	4	1	31	0	0	2781	3046
10.00 - 11.00	17	0	937	7	1301	664	1	0	0	32	0	0	15	0	0	2974	3038
11.00 - 12.00	15	0	853	2	1143	800	0	0	0	16	0	0	23	7	1	2860	3091
12.00 - 13.00	8	0	714	3	984	436	5	0	0	17	1	0	11	0	0	2177	2391
13.00 -14.00	6	2	515	11	518	533	3	1	0	31	1	0	7	0	0	1628	2054
14.00 - 15.00	17	2	483	12	520	400	4	0	0	47	1	0	14	1	0	1501	1808
15.00 - 16.00	13	28	449	18	563	203	3	0	0	26	16	0	11	0	0	1330	1402
16.00 - 17.00	12	19	438	14	503	283	2	0	0	40	40	0	35	0	0	1386	1571
17.00 - 18.00	31	13	505	18	528	333	1	0	0	34	35	0	25	0	0	1523	1775
18.00 - 19.00	16	6	480	14	618	267	2	0	0	26	24	0	32	0	0	1485	1820
19.00 - 20.00	13	3	775	11	630	512	5	4	2	11	10	1	19	0	0	1996	2390
20.00 - 21.00	24	0	450	8	593	354	12	2	1	4	8	0	13	0	0	1469	1724
Total	235	96	9042	177	11744	6159	51	14	4	388	148	2	382	8	6	29556	32259

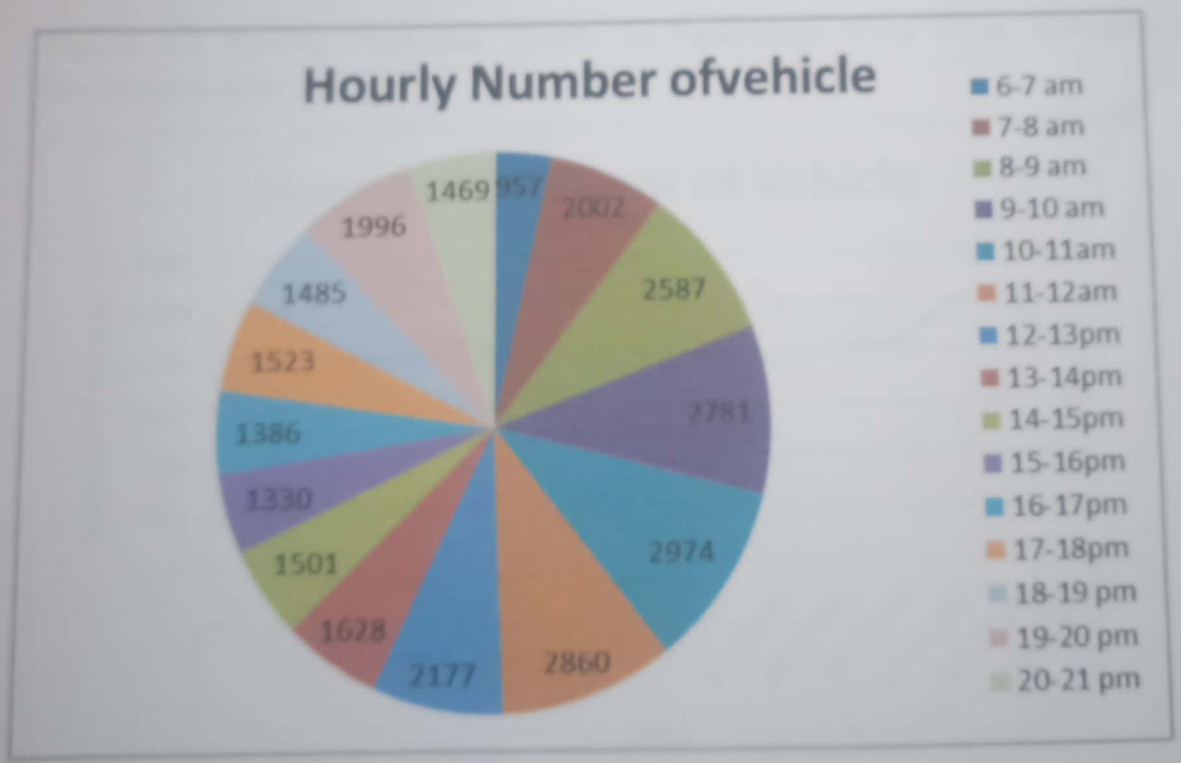

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Figure 4-1 Hourly Vehicle Traffic (Number) from Abbigere Main Road to Renaissance appt

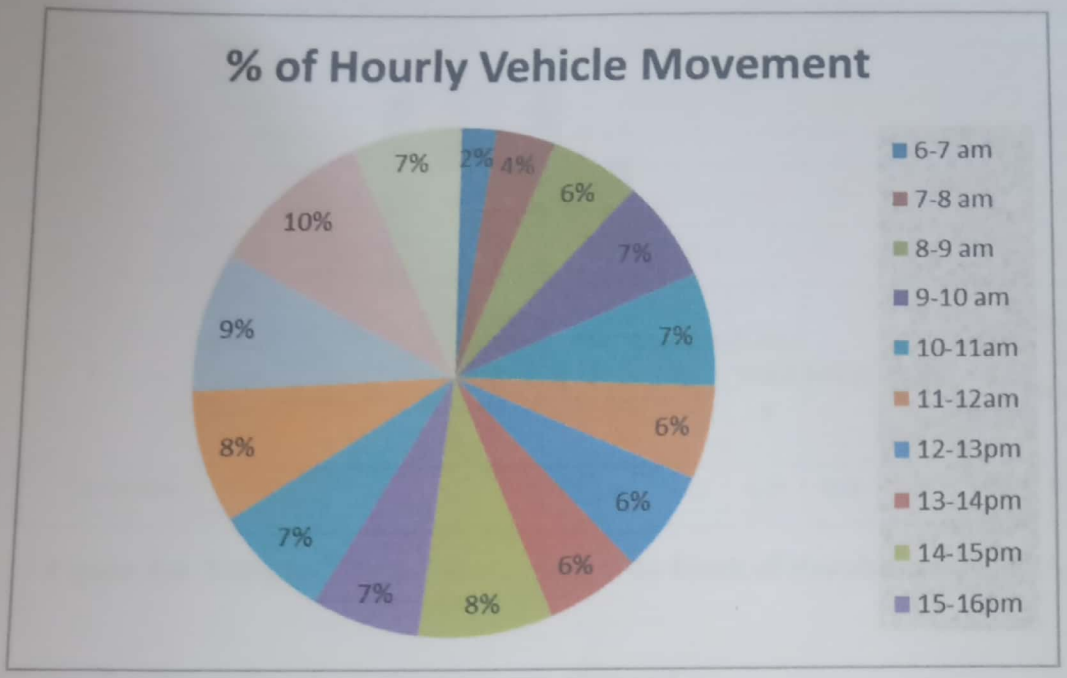

Figure 4-2 Hourly Variation Traffic in Percentage from from Abbigere Main Road to Renaissance appt

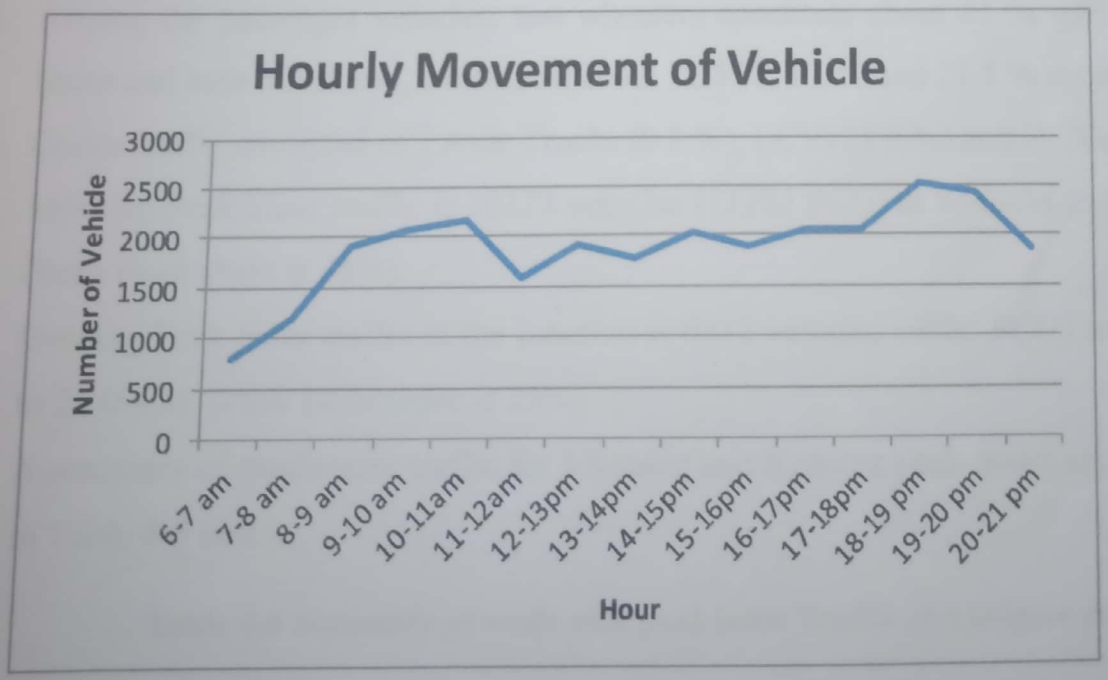

Figure 4-3 Hourly variation of Traffic Flow

The percentage share of different category of vehicles in the total traffic stream in terms of number of vehicles at the survey location has been analyzed. The traffic composition observed in this survey locations are plotted graphically is shown in Figure 4-4 below.

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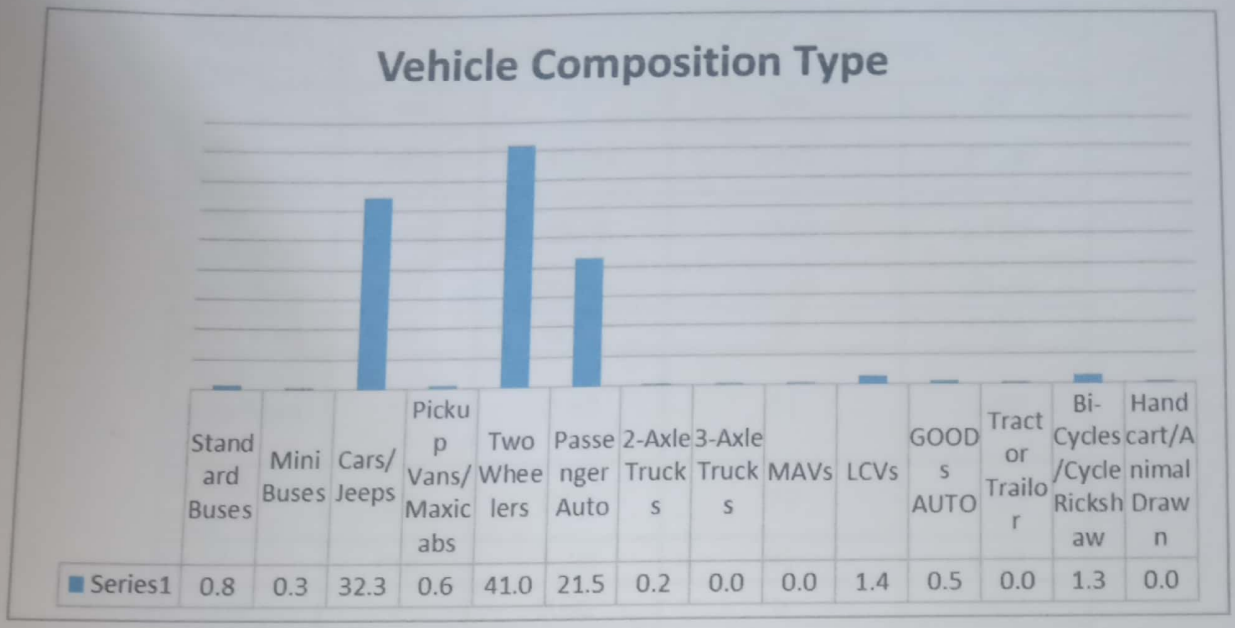

Figure 4-4 Vehicle Composition Type at Mid-block of Renaissance wood Apartment Road

From the above Graphs followings are assessed

i. Goods vehicles account for 3.45 % and passenger vehicles account for 96.5 % of the total traffic. Non-motorized traffic constitutes about 0.05 % of total vehicles.

ii. Among the passenger vehicles, two wheelers constitute about 41 % whereas cars, buses and auto rickshaws, constitutes about 32.3 %, 1.1 % and 21.5 % respectively.

iii. Goods traffic consisted of 2 Axle Trucks (0.2 %), LCVs (1.9 %) and HCVs (0%).

iv. Morning Peak Hour traffic is 10173 vehicles (11105 PCU) at 8.00AM to 12.00AM. (Peak Hour share is 36%)

v. Evening Peak Hour traffic at the junction is 6412 vehicles (9080 PCU) at 17.00PM to 21.00PM. (Peak Hour share is 23%)

vi. A summary of mode-wise traffic for Morning and Evening peak hours are presented in Table 4-5 below.

Table 4-5 Summary of mode wise peak hour Traffic at Abbigere main road

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Vehicle Type	Morning		Evening	
	No	%	No	%
Two Wheelers	4812	47.30	2417	37.69
Auto Rickshaw	1938	19.05	1514	23.61
Car/ Jeep	3032	29.80	2145	33.45
Mini Bus	16	0.16	19	0.30
Picup vans/Maxi cab	50	0.49	51	0.80
Stand. Bus	62	0.61	79	1.23
LCV	118	1.16	91	1.42
2-Axle	0	0.00	6	0.09
3-Axle	0	0.00	0	0.00
Multi Axle	0	0.00	0	0.00
Tractor	1	0.01	1	0.02
Hand Cart /Animal	0	0.00	0	0.00
Bi Cycle / Cycle Riksha	144	1.42	89	1.39
Total	**10173**	**100.0**	**6412.0**	**100.0**

4.5 Traffic Survey between Renaissance wood apartment to Abbigere main road via wimac Junction Ch 0 to 1230

4.5.1 Analysis of Classified Traffic Volume Counts

Classified Volume Count Survey CVC at point-2 is carried out at mid-block of Wood apartment road to Abbigere main road. Traffic flow is two way directions. CVC is done for one day count from morning 6 am to evening 9 pm for 15 hours to assess the volume of traffic flow. The survey for this location is analyzed in order to obtain the following traffic characteristics:

- Average hourly variation of traffic volume
- Average Composition of traffic

The project road observes about 18537 Vehicles (21322 PCU) covering Morning to Evening including Peak hours. Hourly counts of different types of vehicles are shown in Table 4-6. The composition of fast moving motorized vehicles is about 95.20 percent. The number of vehicles and percentage of compositions in hourly are shown in Figure 4-5 and Figure 4-6 . Hourly variation of traffic is shown in Figure 4-7 below.

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